# Visual categorisation of natural movies by rats

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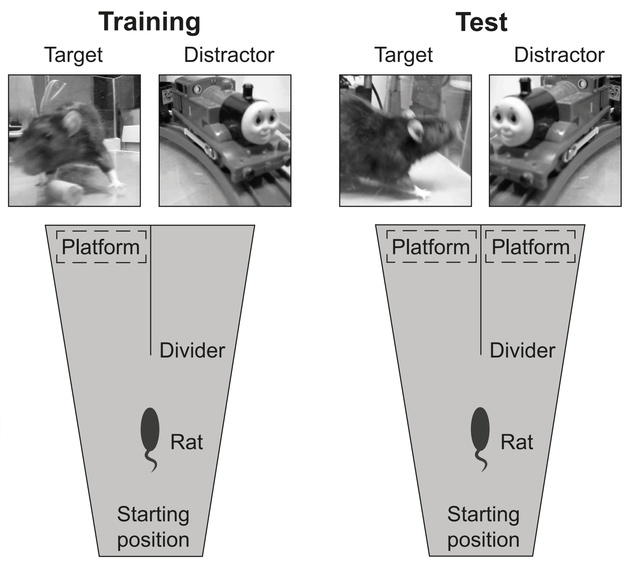
## Introduction

- Visual categorization of complex, natural stimuli has been studied for some time in human and non-human primates.
- Recent interest in the rodent as a model for visual perception, leads to the question of how rodents would perform on a categorization task using natural stimuli.
- Rats were trained to discriminate target movies containing rats from distractor (non-rat) movies.
- Tansfer to 15 novel, previously unseen target movies and their matched distractors was tested, followed by a series of control probes.

## Methods

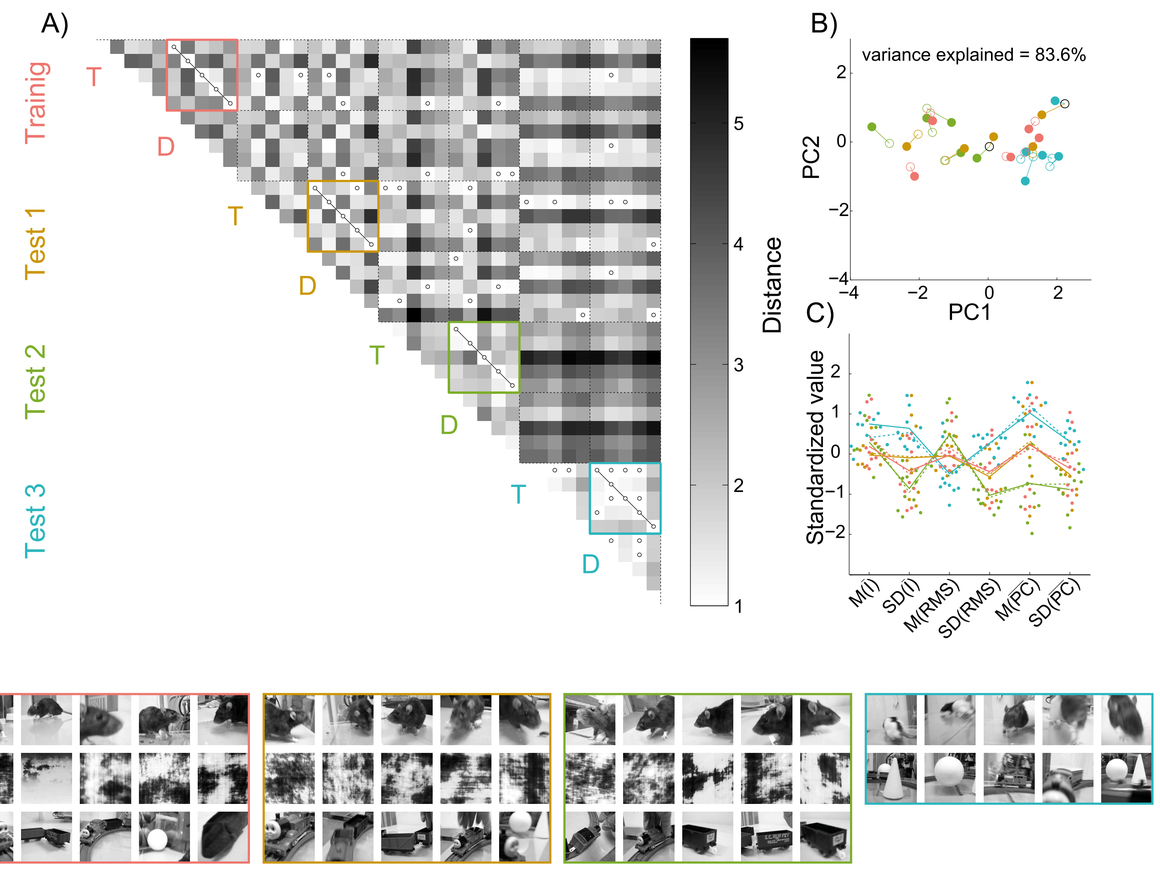
### *Setup and task*

- 6 male FBNF1 rats.
- 2AFC task in a visual water maze.
- One subject was excluded as a result of extreme response bias.
- Performance on previously unseen test movies: 3 test sets with 5 novel pairs each.




### *Stimuli*

- Rat versus object, or rat versus scrambled.
- Rat and object stimulus pairs matched based on 6 pixel-based stimulus properties:
  - M and SD of pixel intensity
  - M and SD of RMS contrast
  - M and SD of change in pixel intensity
- The similarity matrix using the 6 pixel-based dimensions:






### *Data analysis*

- A within-subject logistic-binomial model:

$$y_{ij} \sim B\left(n_{ij}, p_{ij}\right)$$

$$p_{ij} = \text{logit}^{-1}\left(\mu + \alpha_i SET_i + \beta_j RAT_j + \gamma_{ij}\left(RAT \times SET\right)_{ij} + \varepsilon_{ij}\right)$$

$$\beta_j \sim N\left(0, \sigma_\beta^2\right)$$

$$\gamma_{ij} \sim N\left(0, \sigma_\gamma^2\right)$$

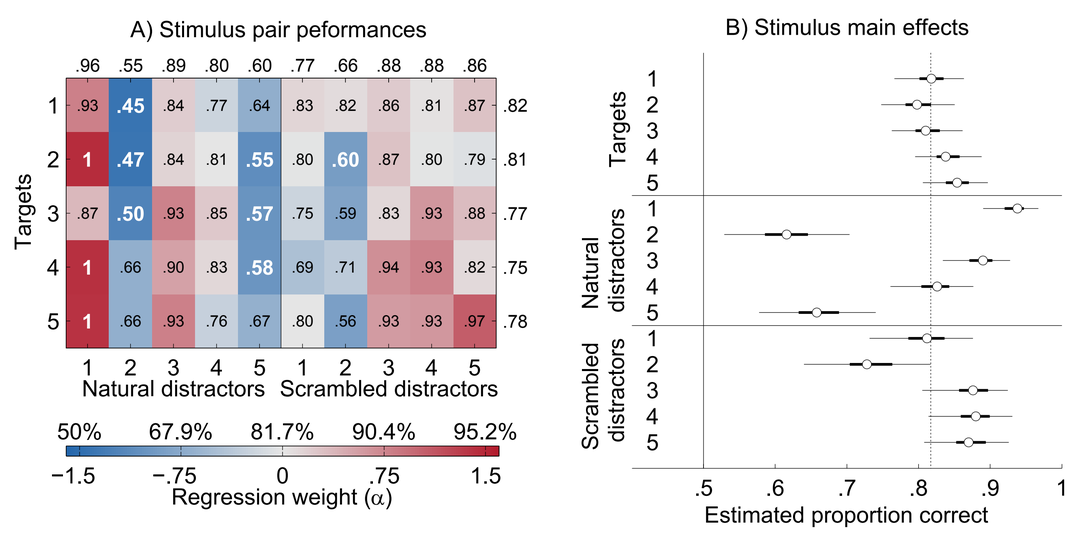
$$\varepsilon_{ij} \sim N\left(0, \sigma_\varepsilon^2\right).$$

- Estimate posterior distribution in JAGS based on non-informative prior distributions.

## Results

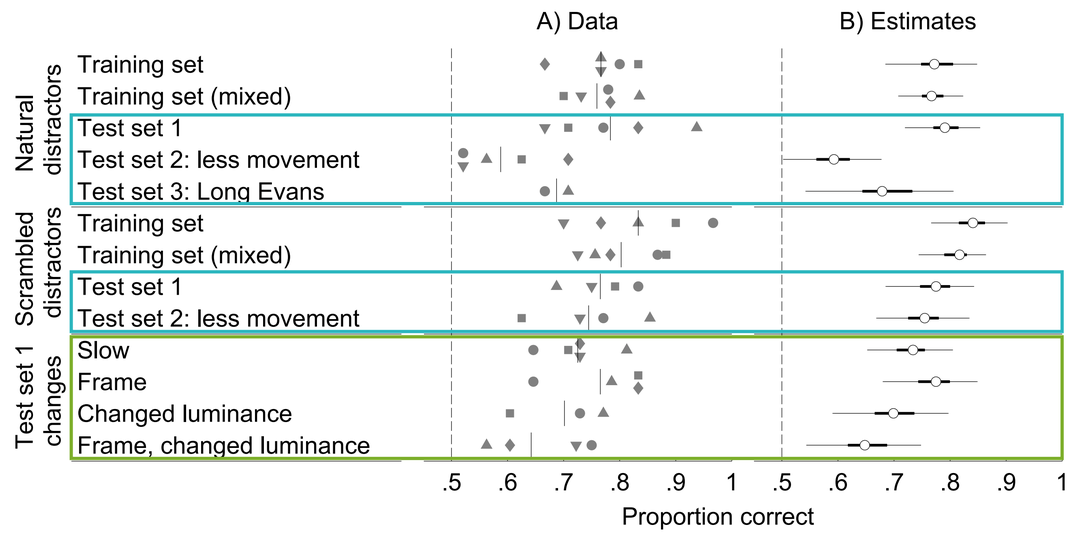
### *Training stimuli*

- Training generalizes to other target-distractor combinations.
- The columnar pattern in the heat map indicates performance is mostly modulated by distractors.



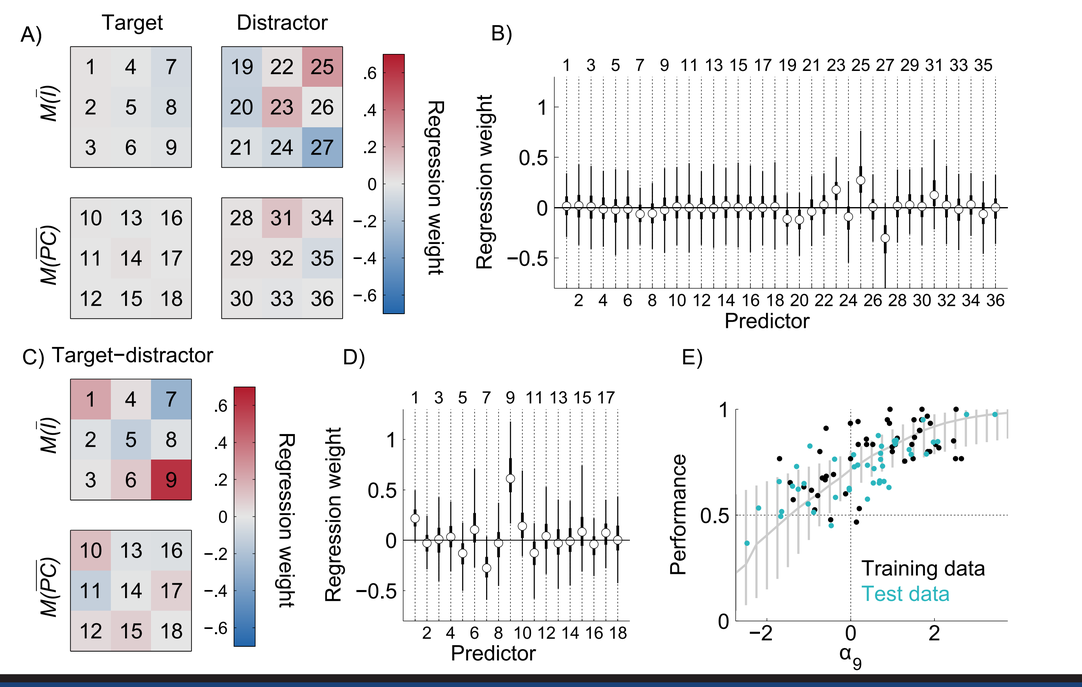

### *Generalization to new stimuli*

- Successful generalization (**blue**) to:
  - a typical test set (*Test set 1*)
  - more stationary rats/objects (*Test set 2*)
  - differently colored rats (*Test set 3*)
- Control probes (**green**) proved that **motion was not a critical factor** (*Slow & Frame*). A possible confound of a difference in average luminance in the lower part of the screen was also ruled out (*Changed luminance*).




### *Local luminance strategies*

- Fit model to the data for the training stimuli using local luminance (changes) as predictors (panel A and B).
- Attempt the same for target - distractor difference (panel C and D).
- Intercept is still 71.5% correct (95% HDI [61.4 80.0]) for the intercept, i.e. when there is no information in the difference template (panel E).




## Conclusions

1) Rats are capable of **acquiring a decision rule** by abstracting common features from natural movies **in order to generalize** categorization to new stimuli.

2) They **did not use single low-level features**, such as motion energy or (local) luminance.